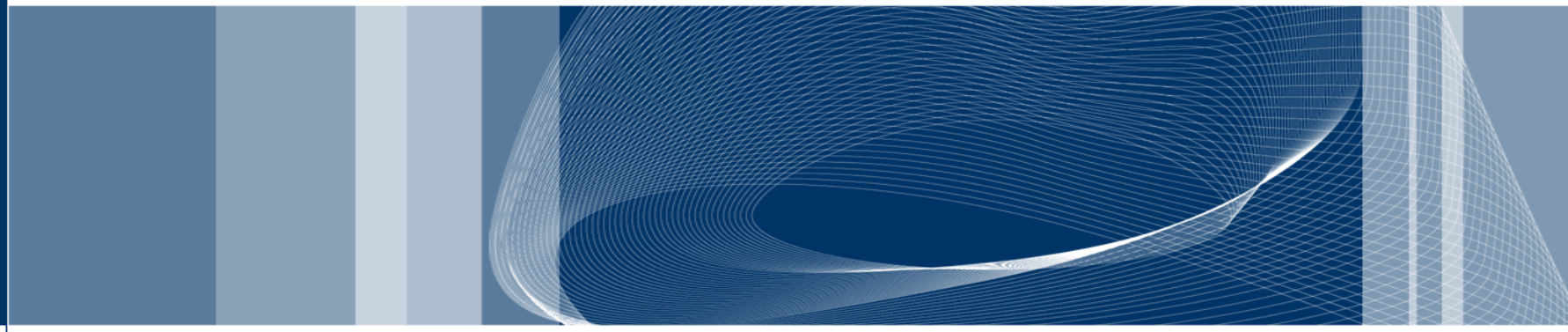
POLITECNICO DI MILANO

Department of Civil and Environmental Engineering
Courses of FLUID LABS and NUMERICAL FLUID LABS



Some best practices in applied CFD

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Best practices in applied CFD

Workflow

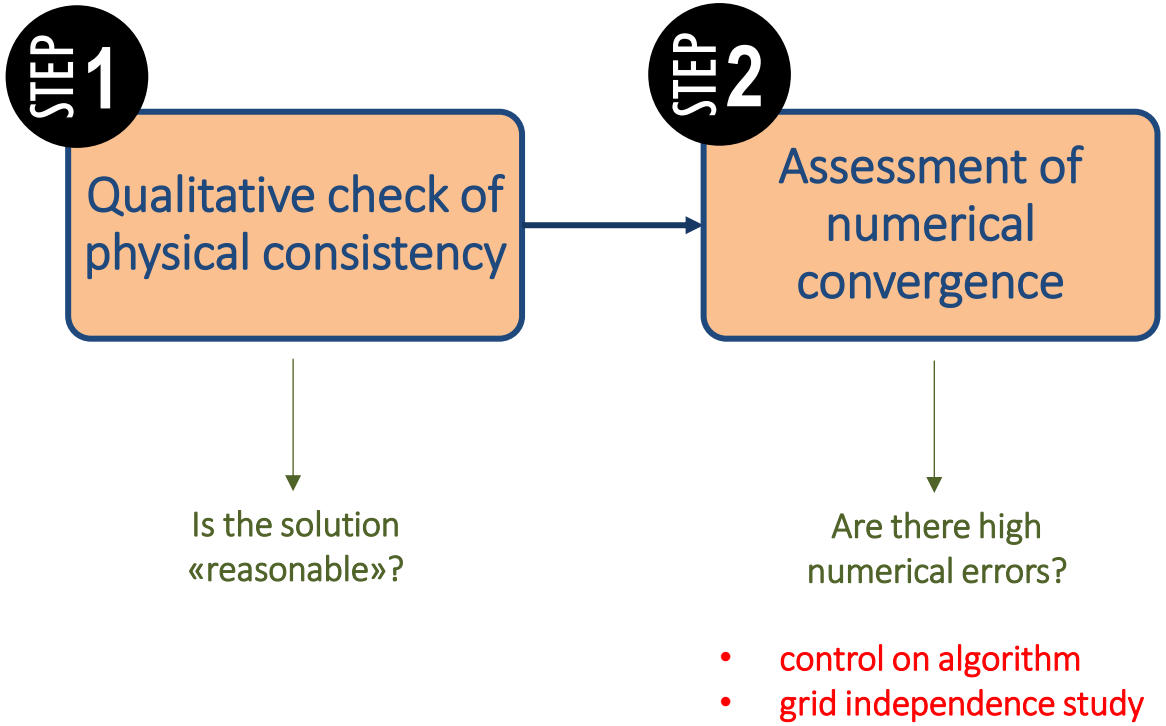
STEP 1

Qualitative check of physical consistency

Is the solution «reasonable»?

Best practices in applied CFD

Workflow



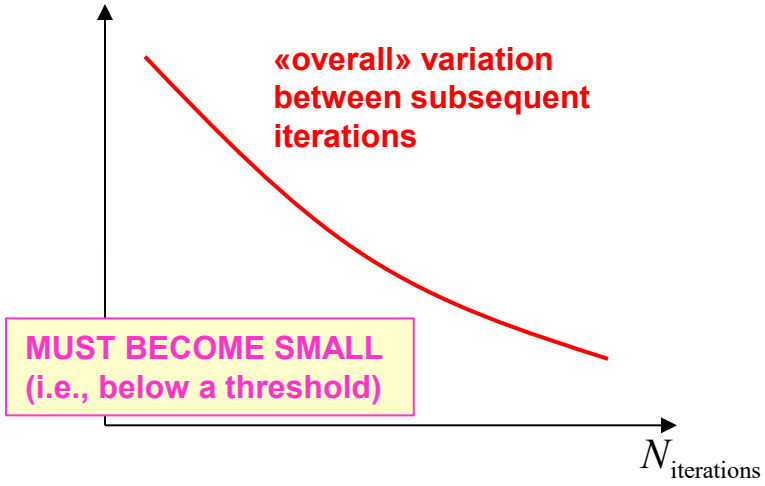
Assessment of numerical convergence

Control of iterative algorithm

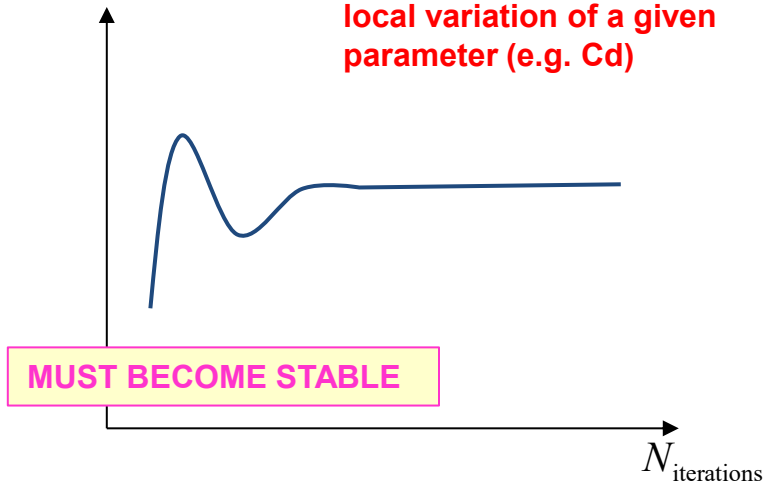
The solution of the discretized equations is performed in an **iterative way**

How can I guarantee that the solution is converged?

Whole-field residuals



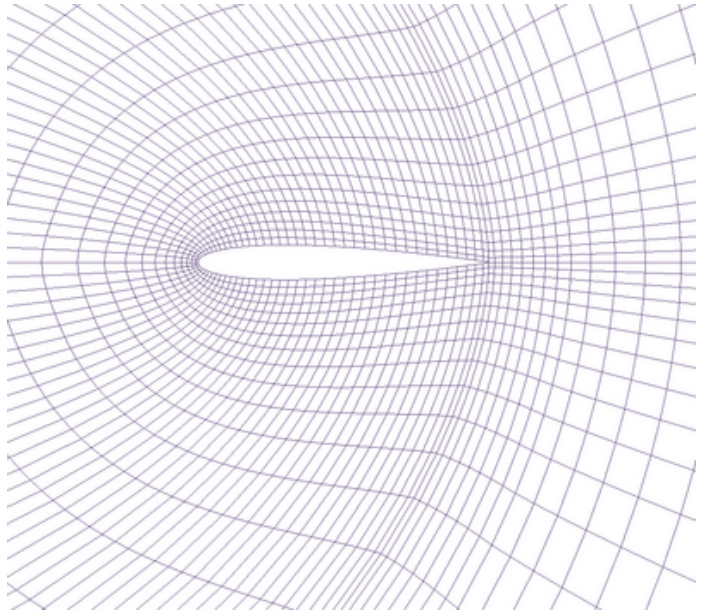
Target parameters



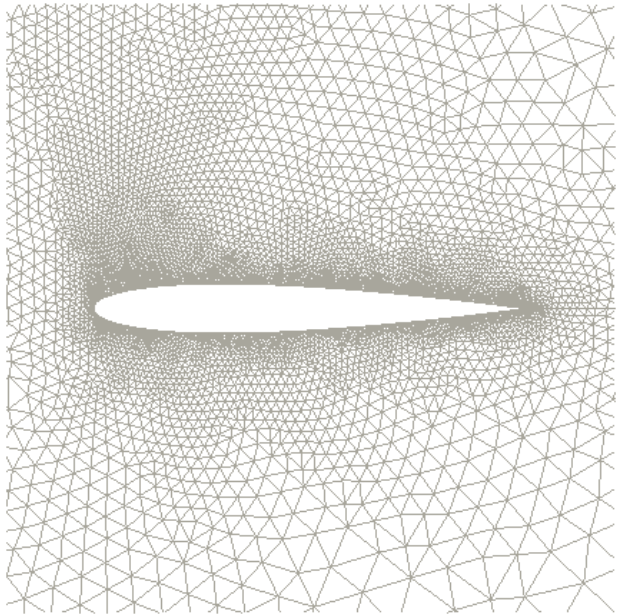
Assessment of numerical convergence

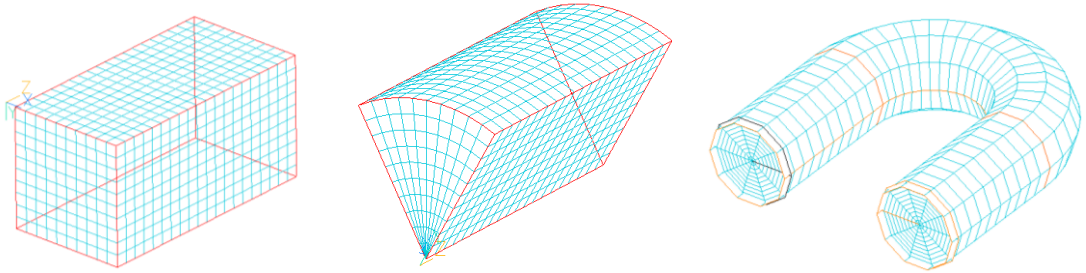
Types of meshes

Structured mesh



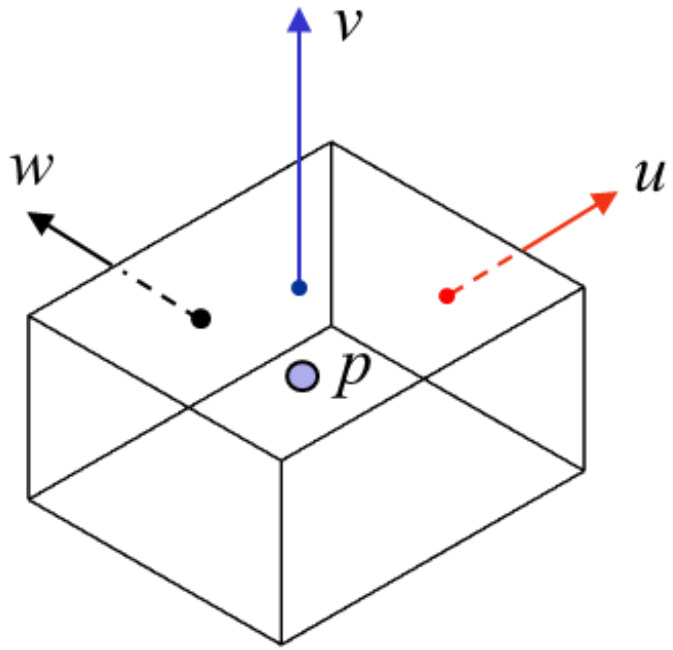
Unstructured mesh



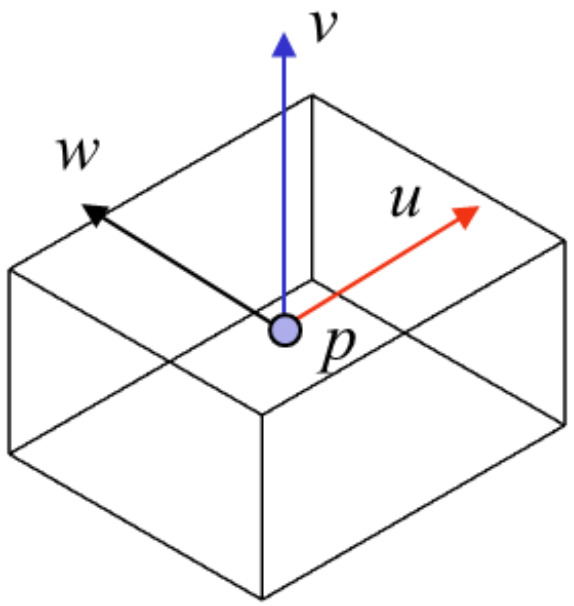


Assessment of numerical convergence

Staggered grid arrangement



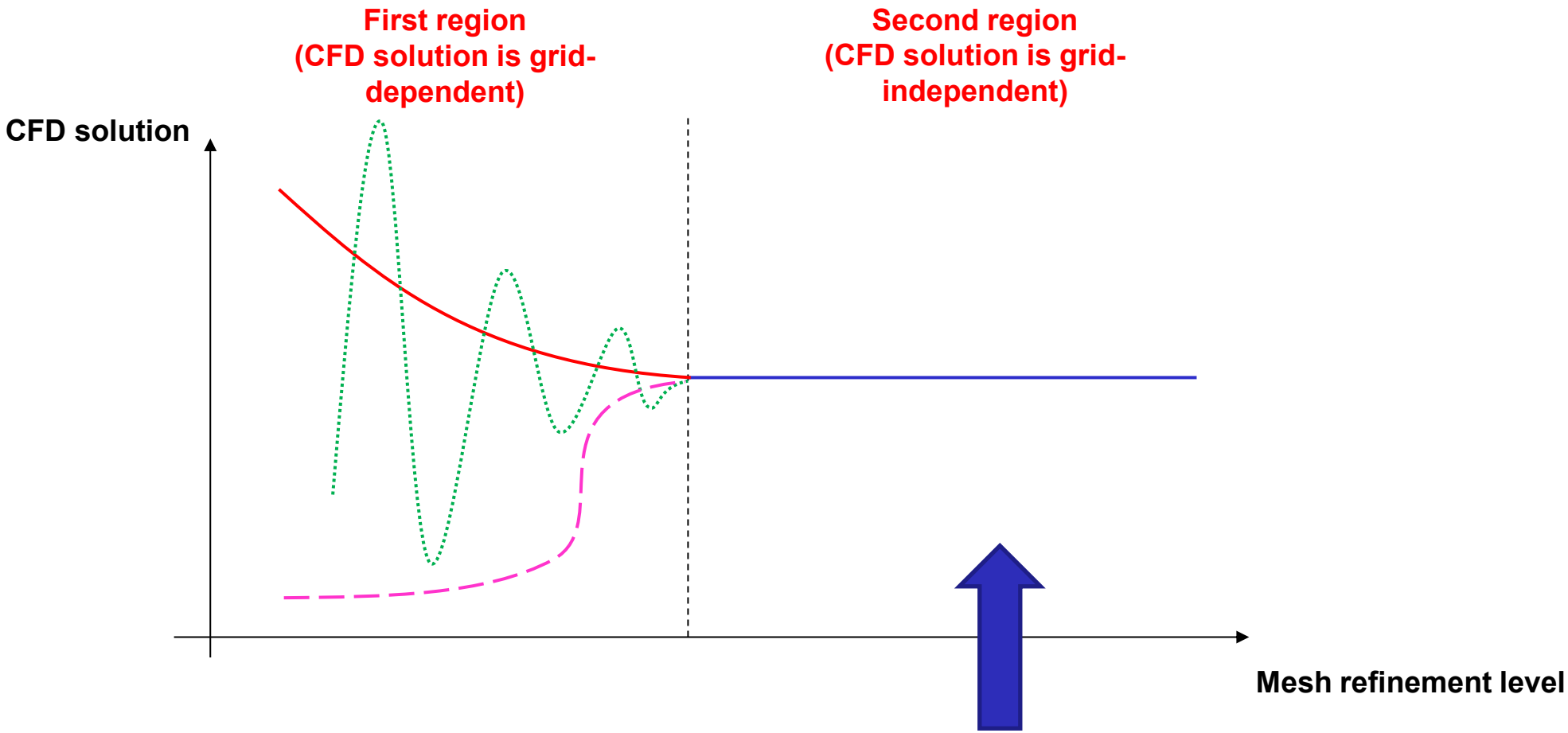
Staggered grid arrangement



Co-located grid arrangement

Assessment of numerical convergence

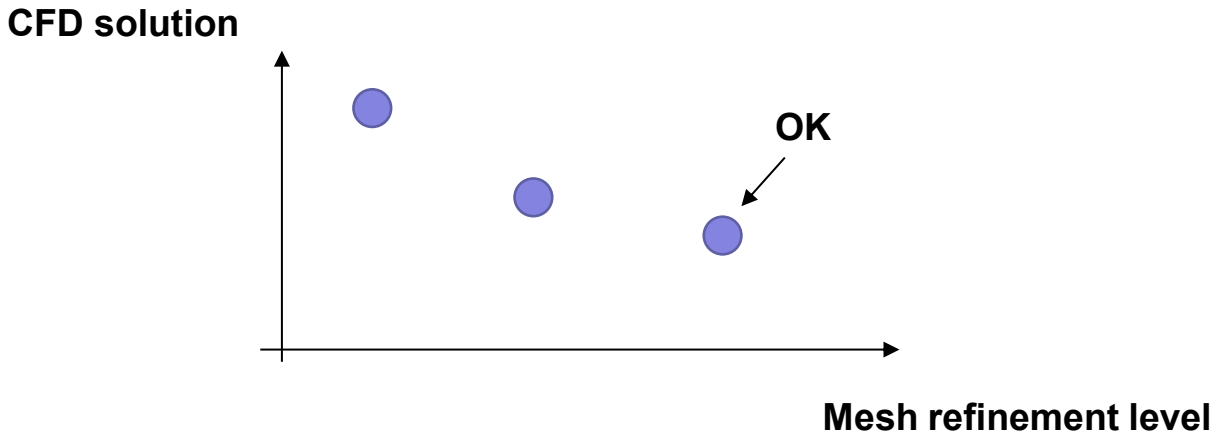
Grid independence study

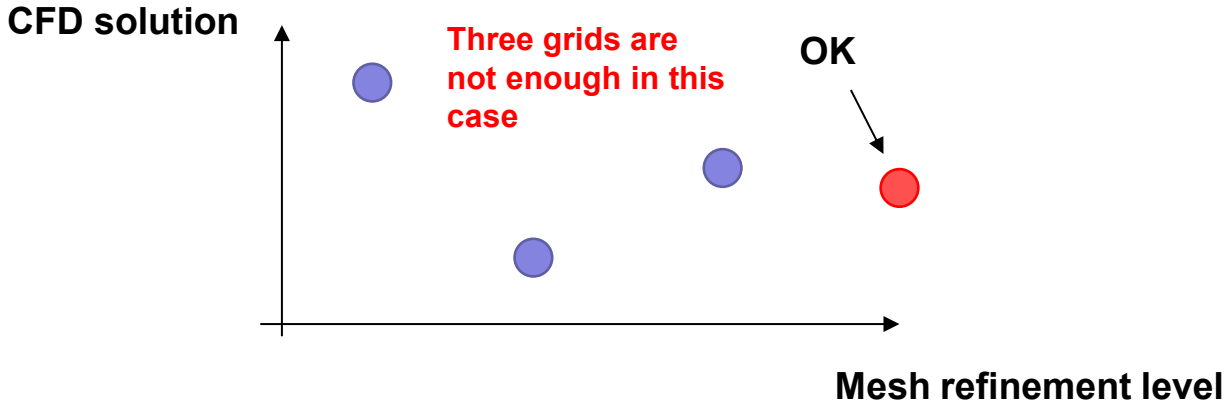


Assessment of numerical convergence

Grid independence study

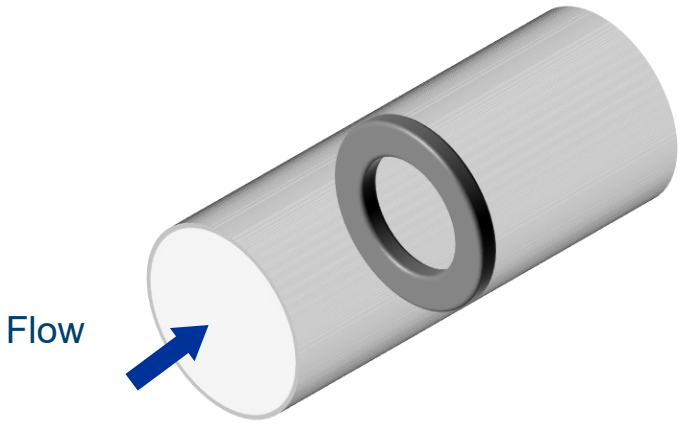
- Run several simulations increasing the mesh refinement level (number of cells?) and try to identify the 2 two regions. In practice, **at least 3 grids** are required.
- I stop when the finest mesh is **in the second region**.
- **But what is f?** Basically, f is the parameter I want to estimate through the numerical simulation (e.g., the pressure drop, the drag coefficient…)
- In principle, the verification of the grid independence of a given f does not extend to **other features of the solution.**

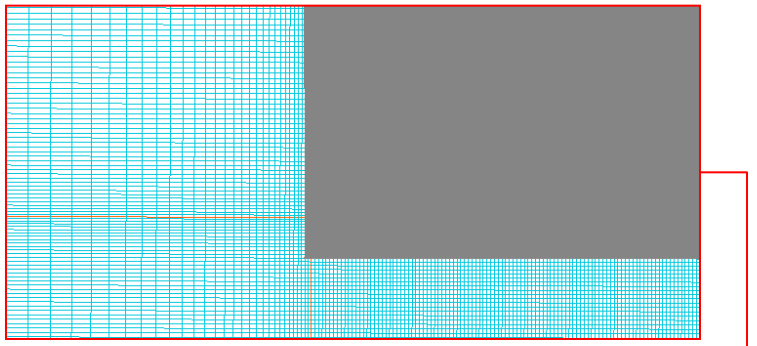


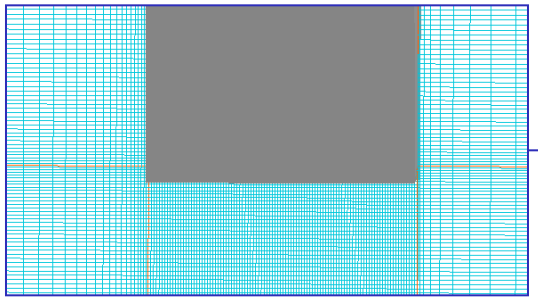


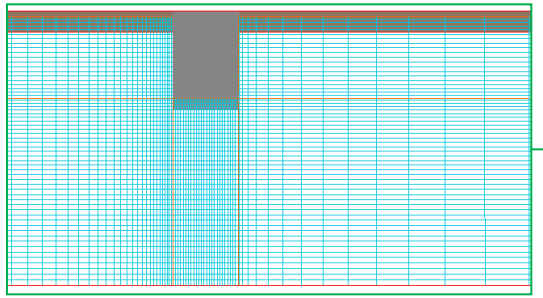
Assessment of numerical convergence

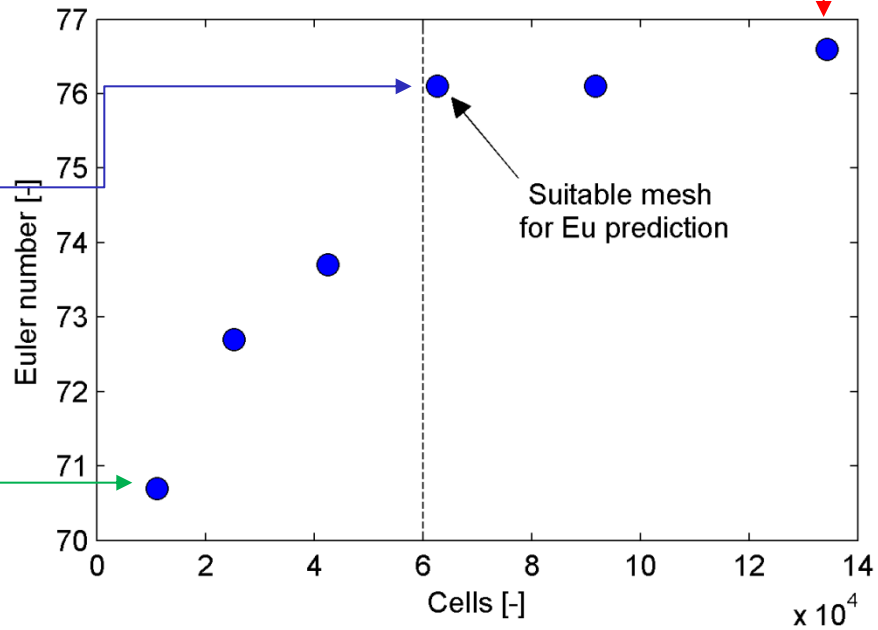
An example of grid independence study









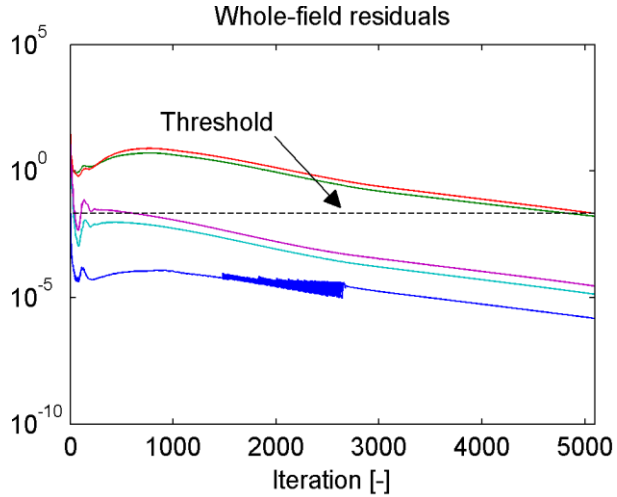


Assessment of numerical convergence

Best practice

It is clear that, for each simulation, the attainment of convergence with respect to the **number of iterations** must be verified.

The number of iterations requried to reach convergence increases with the **grid refinement level.**



Best practice in CFD